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ABSTRACT

Active and passive sentences were presented with probable and improbable semantic content to 100 first graders and 100 kindergartners. "Irreversible" sentences were considered improbable. In a design employing syntax, probability, grade, and sex as factors, probability and syntax were found significant both as main effects and in their interaction. Probability had little effect on the comprehension of active sentences, but strongly affected comprehension of passive sentences. First graders responded correctly more often than kindergartners; the difference was greatest on improbable sentences, with improbable passive sentences the most difficult. Sex differences were not found. The greater difficulty in comprehending less familiar sentences when syntactic form is not supported by semantic content suggests that the semantic component of grammar may play an important role in the child's acquisition of syntactic comprehension. (Author)

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Reversing Irreversible Sentences: Semantic Constraints Upon Syntactic Comprehension

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Abstract

Active and passive sentences were presented with probable and improbable semantic content to 100 first graders and 100 kindergarteners. "Irreversible" sentences were considered probable and the reverses of these sentences were considered improbable. In a design employing syntax, probability, grade, and sex as factors, probability and syntax were found significant both as main effects and in their interaction. Probability had little effect on the comprehension of active sentences, but strongly affected comprehension of passive sentences. First graders responded correctly more often than kindergarteners; the difference was greatest on improbable sentences, with improbable passive sentences the most difficult. Sex differences were not found. The greater difficulty in comprehending less familiar sentences when syntactic form is not supported by semantic content suggests that the semantic component of grammar may play an important role in the child's acquisition of syntactic comprehension.

Reversing Irreversible Sentences: Semantic Constraints Upon Syntactic Comprehension[1]

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It is clear that children's comprehension of syntax increases during the preschool and early school years. The role of semantic features in this development, although they are necessarily involved in the sentences used for testing comprehension, has received less attention.

Comprehension of active voice sentences precedes comprehension of passive voice sentences (Fraser, Bellugi, and Brown, 1963). In a passive voice sentence such as "The cat was chased by the dog", the subject does not precede the noun, as it does in the more familiar active sentences.

Differences are observed (Turner and Rommetveit, 1967) in the ease with which two types of passive sentences are comprehended. Irreversible passive sentences are comprehended earlier than are reversible passive sentences. In reversible passive sentences, the subject and object can readily be exchanged to form a meaningful sentence. The listener must, therefore, attend to syntactic features

Footnotes

[1]We are greatly indebted to Sally Moyer for her participation in planning the study and testing the children and to James Fleming for his generous advice and encouragement.

such as word order and the passive marker "by" to determine which of the two possible interpretations is correct. In an irreversible passive sentence such as "The dishes were washed by the grandmother", the semantic features make only one interpretation probable, and comprehension is facilitated. The reversible passive sentence and its reverse have identical syntactic form; it is only the semantic features which differ.

The earlier comprehension of irreversible sentences seems to indicate that semantic features can affect comprehension of sentences in a given syntactic form. Turner and Rommetveit, however, presented only the probable version of irreversible sentences, although they presented both versions of the reversible sentences.

Gowie and Powers (1971) more explicitly studied the effect of semantic features by presenting children with sentences which were harmonious, neutral, or contrary to the expectations expressed by another group of children. They found that children's expectations helped them to understand both active and passive sentences in the "harmonious" condition, and hindered comprehension in the "contrary" condition. The effect of expectations was significant even though the sentences used were only mildly improbable.

If there is a strong contrast between sentences in which both syntactic and semantic cues point to the same interpretation and sentences in which the cues conflict, the relative contribution of each factor may be more clearly assessed. In this study both probable and improbable sentences were presented in active and passive voice. Probable sentences are identical with those which

have previously been termed "irreversible", and improbable sentences are the reverse of the "irreversible" sentences.

Sentence reversibility may be represented as a continuum rather than a dichotomy. Sentences which are easily reversible range close to the center of this continuum. Highly probable "irreversible" sentences (sentences for which only one arrangement of actor-action-object would be judged likely to occur) are at one pole, and the highly improbable reverses of these sentences are at the other pole. Turner and Rommetveit's study employed reversible sentences very close to the center of this continuum, and irreversible sentences from one pole. Gowie and Powers' sentences ranged a little further from center in both directions. The present study attempts to use sentences not far from the poles -- sentences for which one interpretation is clearly more probable, but for which the reverse is not inconceivable.

This methodological choice reflects several assumptions:

1. Reversibility is not a syntactic feature, but a semantic one. The semantic features of sentences used in testing comprehension of syntax may (a) be assumed irrelevant, (b) be implicit in directing choice of sentences but remain confounded with syntactic features in the analysis, or (c) be explicitly controlled and analyzed.

2. The effect of semantic probability may vary with the familiarity or complexity of the sentence transform presented.

3. The effect of semantic probability may vary with the child's age and ability to process and organize information.

4. The effect of sex has received relatively little attention. Gowie and Powers', while finding no main effect for sex, report that it enters into several interactions.

In order to analyze the effects and interactions of the relevant factors, a design employing semantic probability, syntactic voice, grade level and sex was employed.

It was predicted that there would be more correct responses to probable sentences than to improbable, and that the difference in probable and improbable sentences would be greater in passive sentences than in active sentences. It was expected that active sentences would receive more correct responses than passive sentences, and that first graders would respond correctly more often than kindergarteners. Sex was not expected to be a major factor, but was included in order to analyze possible interaction with other factors.

METHOD

Subjects

A sample of 200 kindergarten and first grade students from 12 classrooms in two predominantly middle to lower middle class public schools in Schenectady, New York, was tested. There were four groups of 50 subjects each -- kindergarten male, kindergarten female, first grade male, first grade female. For one portion of the analysis, the responses of an additional group of 18 children in prekindergarten classes were analyzed. Each child was randomly assigned to one of four forms and was individually tested.

Materials

Materials for testing included a box of small toys, and forms

listing the sentences which were read to the subject. For each of the eight pairs of toys, there were four possible sentence types -- probable active, improbable active, probable passive, and improbable passive -- but a sentence was presented in only one of these types on each form. The four forms are presented in Table 1. [Insert Table 1 about here]

Procedure

Each child was individually tested in a corner or just outside his classroom. The child was shown a small tiger and kangaroo and told "The kangaroo jumps over the tiger. Show me what happens." If he was unsure of what to do, explanation or a demonstration was provided. After this demonstration item, the examiner said, "Now I'm going to tell you some more sentences. Some of them are silly, and some of them make sense, but whatever I way, I want you to show me with the toys." The examiner read each sentence and noted which of the toys was shown acting upon the other. A correct response to the sentence "The pig was lifted by the elephant", for example, would have the elephant lifting the pig.

Design

Probability, syntactic voice, grade, and sex were factors in a 2x2x2x2 factorial design. Sentence type (voice completely crossed with probability) was nested within sex within grade, with repeated measures (2) for each subject. In a separate analysis of the performance of prekindergarteners, responses were analyzed in a 2x2x2 factorial design with probability, voice and sex as factors. Tukey's test was used for significance of the difference in means by sentence type for each grade and sex.

RESULTS

KINDERGARTEN AND FIRST GRADE

The order of difficulty of the sentence types on each form was essentially the same, and no effect for order was apparent. In general the sentences which received the largest number of errors in the improbable version were those involving people. The possibility that young children have more pronounced expectations for people than for animals or inanimate objects may warrant further study.

Analysis of correct responses revealed significant effects due to probability ($p < .001$), voice ($p < .001$), and grade ($p < .025$). The interaction of voice and probability was significant ($p < .001$), as was the interaction of grade and probability ($p < .01$). The three-way interaction of Grade by Voice by Probability was significant ($p < .05$). The effect of sex was not significant at the .05 level as a main effect nor as a factor in interaction. The analysis is shown in Table 2. [Insert Table 2 about here]

Probability -- Children performed better on probable sentences than on improbable sentences. This finding supports the assumption that semantic features are active in determining response to sentences.

Grade by Probability -- Although the means for kindergarteners and first graders were not significantly different for probable sentences, the mean for first graders on improbable sentences (1.645) was significantly different from the kindergarteners' mean of 1.445 ($p < .05$). First graders were better able than kindergarteners to interpret the relationship indicated by the syntactic form in sen-

tences whose semantic features did not support correct interpretation of the syntactic form. See Figure 1.

[Insert Figure 1 about here]

Voice -- Performance on active voice sentences, as predicted on the basis of previous studies, was greater than on passive voice sentences. The interaction of grade and voice was not significant, nor was the interaction of sex and voice.

Grade -- First graders responded correctly to the sentences more often than did kindergarteners. This is consistent with the previous research indicating growth of comprehension during this age period.

Voice by Probability -- In the active voice, means for probable and improbable sentences were not significantly different, but in the passive voice, the mean for probable sentences was significantly greater than the mean for improbable sentences. The means are shown in Figure 2. The interaction of grade with probability and voice with probability suggests that when children are not yet sure of a linguistic form, the effect of semantic content has the greatest impact.

[Insert Figure 2 about here]

Grade by Voice by Probability -- Since the analysis had shown a significant interaction for Grade by Voice by Probability, Tukey's test for significant difference was applied to these means. With eight treatment means and 196 degrees of freedom, the critical ratio for significance at the .05 level is .213. Any two means differing by at least this amount were significantly different. The mean for kindergarteners on Improbable Passive sentences was

significantly different from the mean for first graders on this construction, which was significantly different from all other means. The active sentences as a group were significantly different from the passive sentences. Probable passive sentences and improbable active sentences showed some overlapping. Interactions are shown in Figure 3.

[Insert Figure 3 about here]

PREKINDERGARTEN

For the prekindergarteners (9 girls and 9 boys), a separate analysis was conducted, as shown in Table 3. Significant main effects were found for Probability ($p < .001$) and Voice ($p < .005$), but not for Sex. The interaction of Sex and Probability was significant ($p < .025$). The Voice by Probability interaction was not significant at the .05 level, but was significant at the .06 level. (See Figure 4).

[Insert Figure 4 about here]

Probability -- The prekindergarteners performed better on probable sentences than on improbable sentences. This finding is consistent with the assumption that semantic features influence response to active and passive sentences.

Voice -- Active sentences were comprehended more readily than Passive sentences. This finding was expected on the basis of previous research with children of this age.

Sex by Probability -- The difference in probable and improbable sentences was not significant for females, but was significant for males, as shown in Figure 5.

[Insert Figure 5 about here]

DISCUSSION

These results strongly support the assumption that semantic

probability is a factor in comprehension of syntax. Comprehension of the syntactic features of the active and passive sentences used in this study shows predictable developmental trends, but superimposed on these trends are developmental trends in the ability to coordinate semantic and syntactic cues.

It appears that the younger children are more strongly influenced in their response by their expectations, as indicated by the grade by probability interaction. The older children, while they may recognize the improbability of a message, are better able to differentiate what they hear from what they expect to hear.

When a sentence is presented in a familiar form such as the active voice, the effect of probability is negligible for first graders, and only slightly greater for kindergarteners, as shown in the grade by voice by probability interaction. The effect of probability in the less familiar passive voice is significant not only for the kindergarteners, but also for the first graders. Improbable passive sentences were comprehended accurately only 70% of the time by the first graders.

It seems possible that still younger children, who are not entirely secure in the active voice and thus more dependent on support from nonsyntactic sources, might show effects of semantic probability even in the active voice. To test this possibility, there were 18 prekindergarteners tested. The trends in development of syntax and semantics are observed also in the prekindergarteners. Probability and voice had significant effects for this group. The difference between means for probable and improbable active sentences was greater than for older children, but the voice by probability interaction was not significant. The inter-

action of sex and probability was significant for the prekindergarteners. Males' comprehension at this age seems to be more sharply affected by probability than is females'.

The data presented here are not sufficient to test the possibility that a child learns the function of syntactic features largely by hearing forms such as the passive voice used in contexts which support the accepted interpretation of the syntactic form. Such information, however, will be required for full understanding of the development of comprehension of syntax and semantics.

Theoretical Implications -- The phenomenon analyzed in this study clearly exists; its nature and theoretical relevance require further consideration. The model of transformational grammar described by Noam Chomsky (1965) assigns to the semantic system a relatively small and passive role in the comprehension of sentences. Although the studies discussed here deal with performance rather than competence, the evidence accumulating suggests that the semantic system plays a more active role.

A brief sketch of the proposed modification of the role of the semantic system is offered. After sounds have been interpreted as words, individual word meanings assigned, and base structural relationships reconstructed, the sentence as a whole is again scrutinized by the semantic system. The meaningful words in the interpreted structural relationship are checked against nonlinguistic information. If the message is felt to be in error, it may be reinterpreted in a form more consistent with expectations.

This evaluative function of the semantic system shows developmental trends consistent with those found in other areas of the

child's development. Young children can only respond globally to the message as right or wrong. Older children are better able to analyze separately the semantic and syntactic features of the sentence. They can thus attend differentially to the cues appropriate for interpretation of the message and the cues appropriate for evaluation of its truth value.

Areas for Further Research -- Semantic probability has been shown to affect comprehension of the sentences which are presented to a child to assess his comprehension of syntax. This information is useful in reappraising previous research and in controlling for this factor in other studies of syntactic comprehension.

A subject which deserves investigation is the effect of the abstractness of the assessment technique upon the estimate of comprehension. The manner of presentation and the response required of the child in the present study were quite concrete, which would seem to allow expression of comprehension by young children with a minimum of performance difficulties. It should be recognized, though, that this is a minimum criterion of comprehension, and as such may be less sensitive to differences as the child approaches fully matured syntactic comprehension, which should be relatively unaffected by semantic content or methodological variations.

It seems desirable to extend investigation of the effect of semantic features upon syntactic comprehension to younger children as they are in the process of mastering the earlier developing sentence forms such as the active, negative, and question. For older children, the effect of probability might be tested not only

in passive sentences, but in other late-developing forms such as the indirect object. Powers' (1973) study of the effect of expectations on comprehension of syntax in kindergarten and first grade, and Gowie's (1972) investigation of the effect of expectations on promise-tell sentences (based on Carol Chomsky's study), represent efforts in this direction.

Since some constructions have been found difficult even for adults (Kramer, Koff, and Luria, 1972), it is possible that such constructions may be sensitive to the effects of probability as judged by the subject. Adults and adolescents, however, are better able to coordinate various cues, test hypotheses, and perform logical operations on propositions, probable or improbable. The present findings cannot be extrapolated to adults without direct evidence.

The semantic features which provide support for syntactic comprehension in the age range tested may also provide the means for learning syntax available to younger children. Discovering the child's own means for learning could have impact for teaching children who have difficulty comprehending language. Semantic support might be provided by grounding unfamiliar constructions in a context which clearly supports the accepted interpretation of a construction and by pairing new syntactic forms with familiar forms.

TABLE 1

SENTENCES

Type	Form A	Type	Form B
IA	The pig lifts the elephant.	IP	The elephant is lifted by the pig.
IA	The toy drops the boy.	IP	The boy is dropped by the toy.
PP	The Indian is carried by the horse.	IA	The Indian carries the horse.
PP	The motorcycle is pulled by the truck.	IA	The motorcycle pulls the truck.
PA	The mother washes the baby.	PP	The baby is washed by the mother.
PA	The cup covers the saucer.	PP	The saucer is covered by the cup.
IP	The father is spanked by the girl.	PA	The father spanks the girl.
IP	The lion is chased by the lamb.	PA	The lion chases the lamb.

Type	Form C	Type	Form D
PA	The elephant lifts the pig.	PP	The pig is lifted by the elephant.
PA	The boy drops the toy.	PP	The toy is dropped by the boy.
IP	The horse is carried by the Indian.	PA	The horse carries the Indian.
IP	The truck is pulled by the motorcycle.	PA	The truck pulls the motorcycle.
IA	The baby washes the mother.	IP	The mother is washed by the baby.
IA	The saucer covers the cup.	IP	The cup is covered by the saucer.
PP	The girl is spanked by the father.	IA	The girl spanks the father.
PP	The lamb is chased by the lion.	IA	The lamb chases the lion.

TABLE 2

ANALYSIS OF VARIANCE

Probability x Voice x Grade x Sex for Kindergarten and First Grade

Source	df	SS	MS	F
Probability (P)	1	14.312		54.84****
GxP	1	1.900		7.28***
SxP	1	.280		1.07
GxSxP	1	.153		< 1
Error 1	196	51.105	.261	
Voice (V)	1	38.282		136.23****
GxV	1	.280		< 1
SxV	1	.150		< 1
GxSxV	1	.053		< 1
Error 2	196	55.005	.281	
Grade (G)	1	2.102		6.11**
Sex (S)	1	.152		< 1
SxG	1	.450		1.31
Error 3	196	67.485	.344	
VxP	1	5.280		21.82****
GxVxP	1	1.053		4.35*
SxVxP	1	.213		< 1
GxSxVxP	1	.779		3.22
Error 4	196	47.425	.242	
Total	799	286.439		

*p < .05, **p < .025, ***p < .01, ****p < .001.

TABLE 3

ANALYSIS OF VARIANCE

Probability x Voice x Sex for Prekindergarteners

Source	df	SS	MS	F
Probability (P)	1	6.12	6.12	17.00****
SxP	1	2.35	2.35	6.53**
Error 1	16	5.78	.36	
Voice (V)	1	7.34	7.34	15.62***
SxV	1	.35	.35	< 1
Error 2	16	7.55	.47	
VxP	1	1.69	1.69	4.12*
SxVxP	1	.01	.01	< 1
Error 3	16	6.55	.41	
Sex (S)	1	.01	.01	< 1
Error 4	16	4.11	.26	
Total	71	41.87		

*p < .06

**p < .025

***p < .005

****p < .001

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Figure 1
Grade by Probability

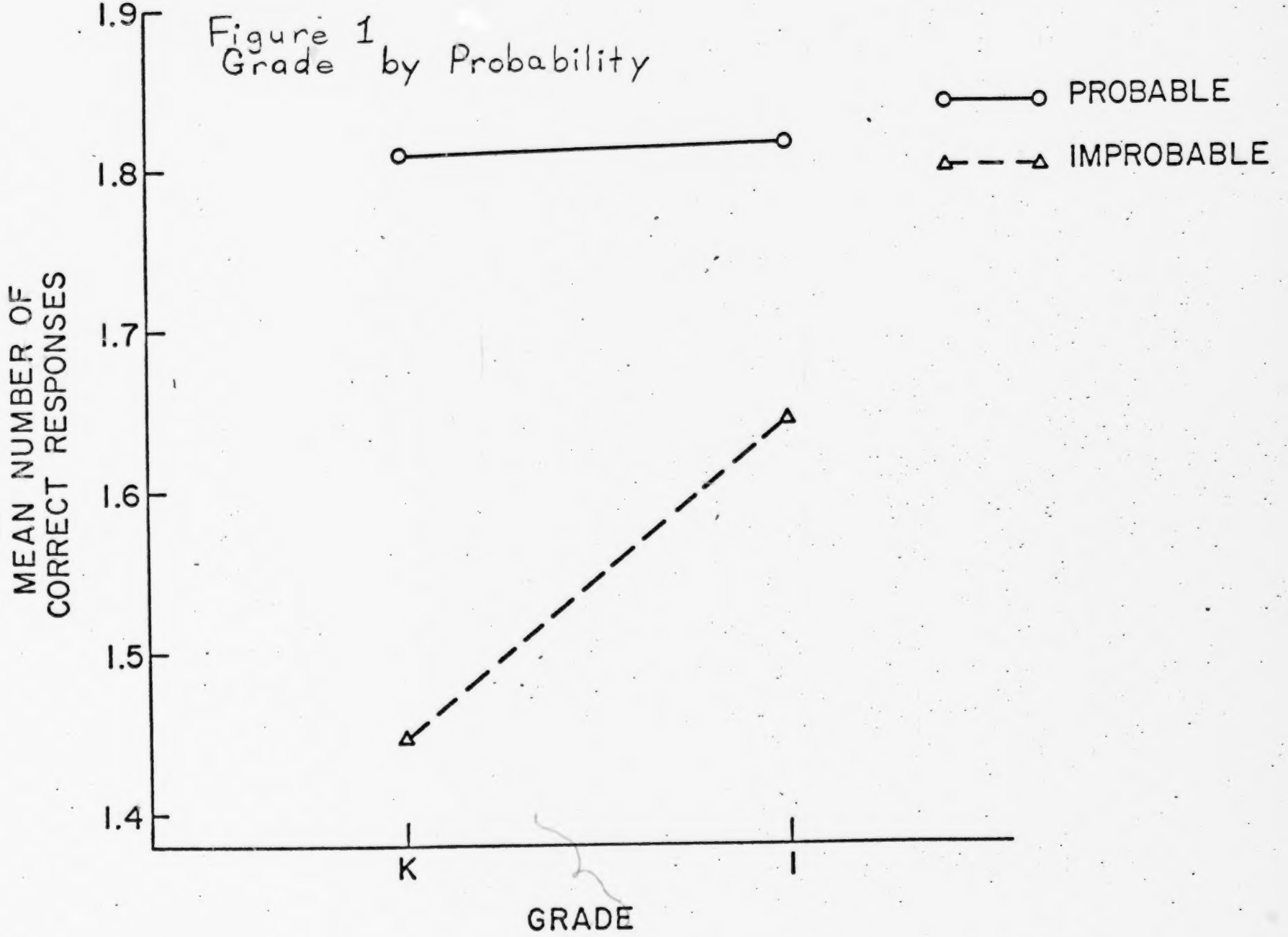

Figure 2
Voice by Probability

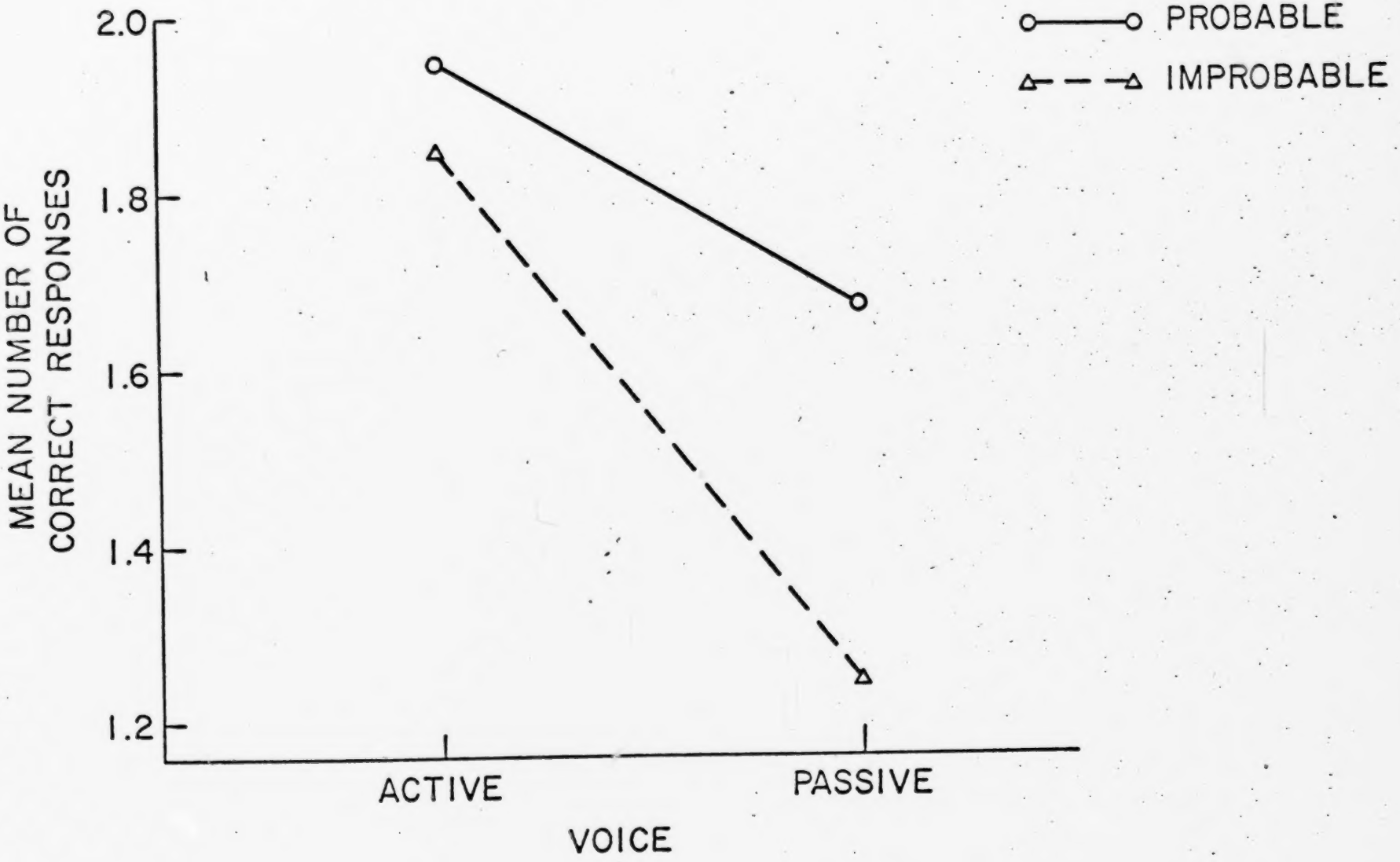

Figure 3
Grade by Voice by Probability

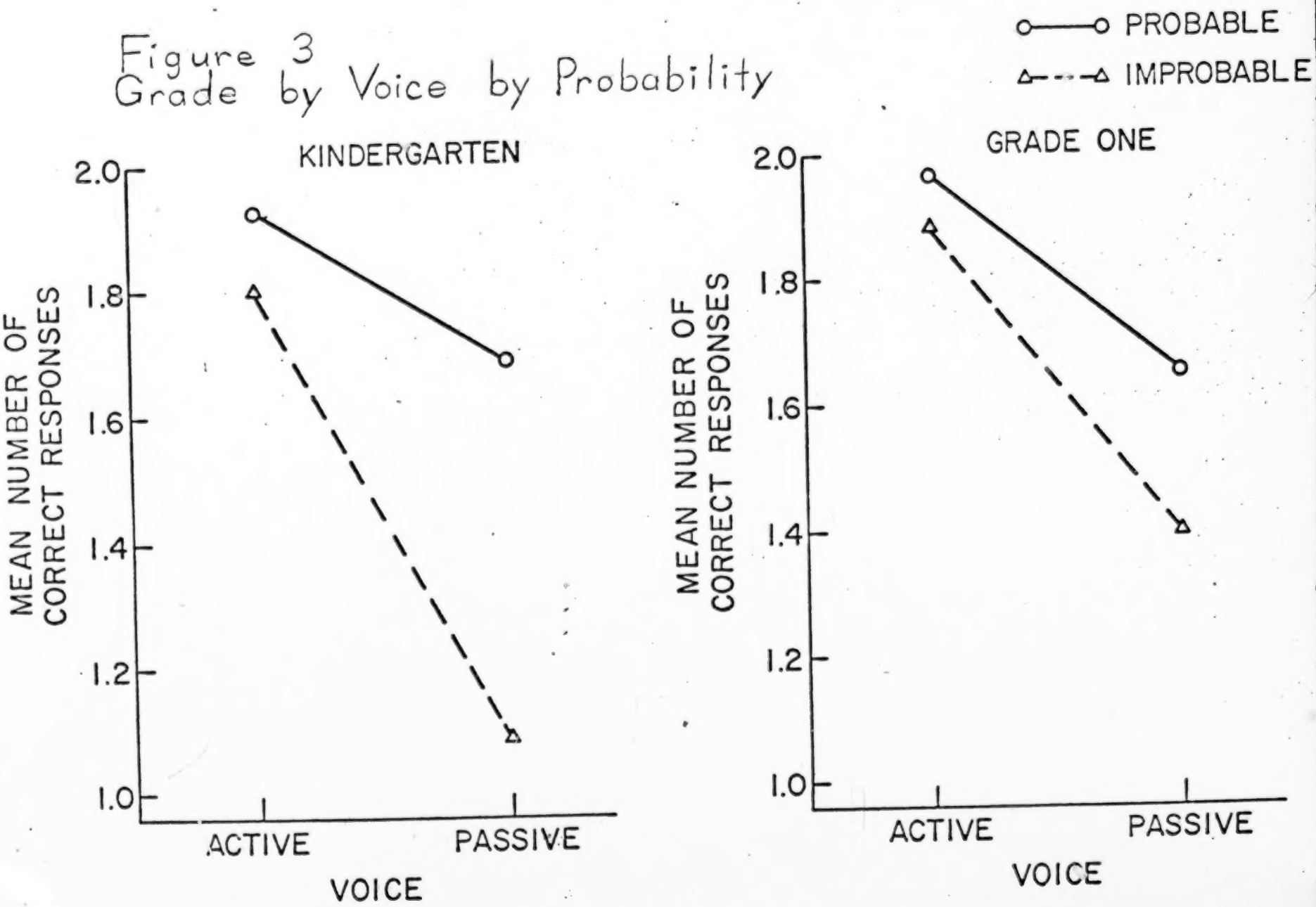

Figure 4
Voice by Probability — Prekindergarten

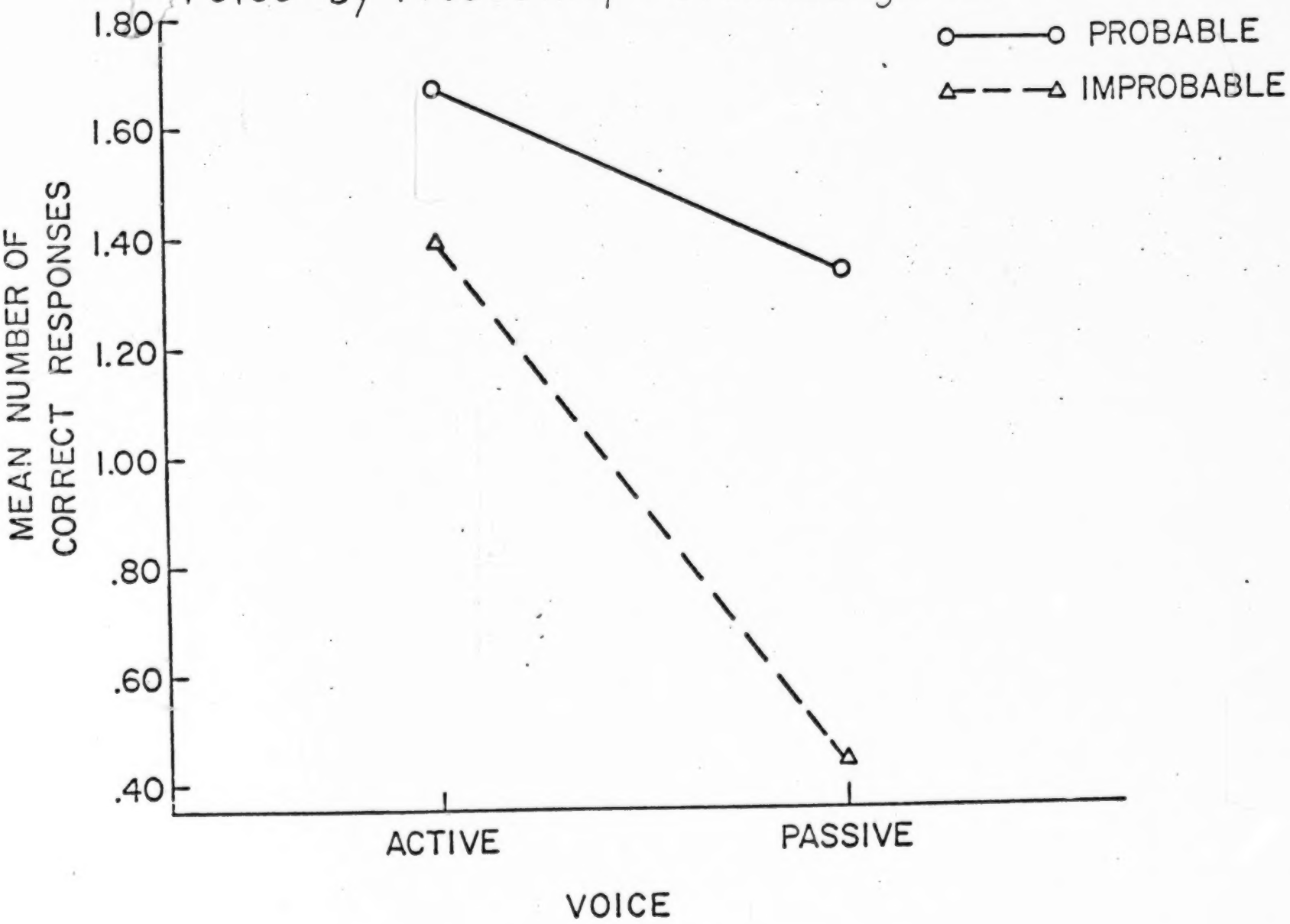

Figure 5
Sex by Probability – Prekindergarten